THE MECHANISM

OF

NATURAL AND OF ARTIFICIAL LABOR

IN

NARROW PELVES.

BY

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"Opinionum commenta delet dies, naturæ judicia confirmat."

CICERO, *De Naturâ Deorum.*

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THE MECHANISM OF NATURAL AND OF ARTIFICIAL LABOR IN NARROW PELVES.

In studying the mechanism of natural and of artificial labor in narrow pelves, let us first inquire what is meant by a narrow pelvis, and what are its kinds.

A pelvis with a true conjugate (*conjugata vera*) measuring less than four inches constitutes a narrow pelvis. For, although the biparietal diameter of the average fœtal head at term measures less than four inches, the working space between the promontory of the sacrum and the symphysis of the pubis is lessened by double the thickness of the uterine wall, and by double that of the vesical wall. While, therefore, the actual conjugate is ample for an average head to pass, the virtual conjugate may be too small. Thus, according to our best authorities, a standard head in a pelvis measuring in its conjugate 3.75 inches—viz., half an inch less than that of the average-sized pelvis—constitutes a difficult labor.

A spontaneous delivery is not impossible under such circumstances, but the forceps will usually be needed; sometimes, indeed, craniotomy. Every line below this measurement greatly increases the difficulties of parturition. For instance, out of thirteen vertex presentations in pelves measuring at the least 3.75 inches, Dubois had three cases of craniotomy or of cephalotripsy. In conjugate diameters between 3.75 and 3.1 inches, he had ten presentations at term of the vertex, and one of the face. Of these, two ended spontaneously, two were delivered by the forceps with the death of one child, and seven needed the cephalotribe.[1] Baudelocque contends that out of five hundred children at term and of average size, hardly one will be delivered alive through a pelvis of three inches. To this, Dezeimeris[2] adds that one of 3.25 inches does not give much better results, and that one of 3.5 inches also offers to the child a very dangerous passage. Joseph Clarke gives,[3] as the result of an experience of 14,077 cases of labor, that "three and a half inches is the least diameter" through

[1] Management of Labor in Contracted Pelves. By Wm. H. Jones. This author, it is true, makes these cases occur respectively in pelves whose conjugates measured "over 3.5," and "between 3.5 and 3 inches." But since he has adopted the classification of Dubois, these figures seem to me incorrect. For Dubois's first and second categories of deformed pelves are those in which the conjugates measure respectively, at the least, 3.75 inches (au moins 9.5 centimètres), and between 3.75 and 3.1 inches (au plus 9.5 centimètres et 8 centimètres au moins). This information I get second-hand from Cazeaux, and not from Dubois, whose thesis is beyond my reach.

[2] Dictionnaire en 30; Art. Accouchements Prématurées, p. 427.

[3] Contributions to Midwifery; by T. E. Beatty, p. 23.

which he has known "a full-grown fœtus to pass entire." Chailly-Honoré says,[1] "The forceps will frequently extract a living child through a conjugate of over nine centimetres (3.54 inches), sometimes, indeed—although this is very rare—under this size." From these facts, the broad rule may be laid down that, when the short diameter of the brim does not exceed the biparietal diameter of the child's head, the unaided efforts of the mother will in general be inadequate to effect a safe delivery, and that even with instrumental aid the life of the child will be greatly imperilled.

The most common kinds of narrow pelvis are three in number:—

(1) The simple, flat pelvis, or conjugate narrowing with correlative transverse widening.

(2) The generally and uniformly narrowed pelvis, in which all the pelvic diameters are symmetrically shortened.

(3) The generally narrowed, flat pelvis, which combines the bone-lesions of the other two, but in varying proportions.

Of these three varieties, the one most commonly met with is the simple, flat pelvis, in which the lesion is limited mainly to the brim and to its posterior half. Practically the obstruction is a marginal one, and is confined to the sacral pole of the conjugate diameter. In the second variety—or the generally and uniformly narrowed pelvis—the obstruction is not a marginal one, nor of limited area, but diffused over every plane of the pelvic canal. In the third variety, the obstruction depends upon the preponderance of conjugate or of transverse narrowing, and is, therefore, either mainly at the brim and marginal, or mainly in the pelvic canal and diffused.

Since "Art is the imitation of Nature, and those will best succeed in any science who closest watch her operations,"[2] let us next note the mechanism of an unaided head-first labor in these different kinds of narrow pelvis.

In the generally and uniformly narrowed pelvis, the mechanism is very analogous to that which takes place in the standard pelvis, but is of course attended with more delay. The head enters the brim synclitically and with the normal Solayrés obliquity—that is to say it engages in one of the oblique diameters of the brim, but without lateral (Nægele's) obliquity. It will also be strongly flexed (Rœderer's obliquity), because the resistance at the brim is equal on all sides, and the shorter hind-arm of the head-lever must therefore descend. The head also begins to flex at a higher plane of the pelvic cavity than in the standard pelvis. For flexion in the latter is chiefly brought about by the resistance of the os uteri; in the former by the more highly situated brim. During the descent of the head, the synclitic movement is preserved except in so far as vertical or lateral shearing interferes with it. Since the absolute conjugate narrowing is rarely great, and the general narrowing is symmetrical in all directions, the furrows or the fractures of the cranium are by no means so common as in the other varieties of deformed pelvis. But, when present, they usually start from the boss of the parietal bone and run more or less parallel to the sagittal suture, as in cases of fracture reported by Lizé[3] and D'Outrepont,[4] and one of depression of the skull by Danyau.[5] It must, however, be borne in mind that, while the bone-furrow always

[1] Accouchements; Paris, 1867, p. 649.
[2] The Present State of Midwifery in Paris; by A. Tolver, 1770, p. 22.
[3] Union Médicale, Fév. 1860, p. 295.
[4] Journal de Chirurgie, par Malgaigne, 1843, p. 41.
[5] Ibid., p. 49.

indicates the transit-line, the fractures do not, as they may radiate from it in every direction.

When left to the unaided efforts of nature, the typical mechanism of a head-first labor in the flat pelvis, or in one whose brim is narrowed mainly in its conjugate diameter, is as follows:—The hind-head offers its biparietal diameter at the conjugate, but cannot enter. The resistance being nearer to the occipital end of the head causes extension, and the fore-head dips. As the fore-head descends, the sagittal suture, losing its Solayrés and Rœderer obliquities, becomes transverse in two senses—viz., it lies in the transverse diameter of the brim, and with the two fontanelles on the same plane. The shorter and more compressible bitemporal diameter—that is to say, the upper or vault portion of each temporal region near the coronal suture—reaches the conjugate, and is driven into it, by the changed direction of the propelling force, which, acting through the vertebral column, is now thrown out of its perpendicularity to the base of the skull, and so bears at an angle directed to the forehead. Thus the head is nipped, bent in on its sacral side, and moulded to the promontory. Sometimes it is the bicoronal (the bifronto-temporal) diameter which is nipped. Hence the frequency of face-presentations in narrow pelves—a frequency, according to Michaelis, eight times greater than in normal pelves.[1] Hence, also, the ease with which the anterior fontanelle is reached, and the corresponding difficulty with which the finger touches the posterior fontanelle.

The resistance is now at a point nearer to the fore-head than to the hind-head, and the latter, therefore, begins to descend, but with the biparietal diameter *to one side* of the conjugate diameter. But the resistance of the iliac margin of the brim to the descent of the hind-head causes that portion of the cranium to expand and to mould itself to the corresponding sacro-iliac space. It also tends to shove the whole head over to the forehead side of the pelvis. In a generally narrowed, flat pelvis with absolute transverse shortening, this displacement in the direction of the occipito-frontal diameter may go on until stopped by the impact of the forehead on the opposite ilium. The head, therefore, passes the conjugate, not vertically in the bicoronal or the bitemporal diameter which first engaged, but along a transit-furrow running somewhat obliquely from that portion of the vault near the coronal suture to the base posteriorly, that is to say, in the resultant of three forces—flexion, uterine propulsion, and occipito-frontal displacement in the transverse (bisiliac) diameter of the brim. In proportion as the head descends, it becomes more and more flexed, and the biparietal diameter, which passed the brim to one side of the conjugate, will, at a later stage of labor, be found almost directly under the promontory. It must, however, be remembered that, since all the transverse diameters of the pelvic cavity are also lengthened out, the head usually descends to the floor of the pelvis with less flexion than in the normal pelvis, and anterior rotation of the vertex is proportionally delayed.

Thus, from the mechanism of natural labor in this kind of pelvis, it will be seen that the head enters the brim in a state of partial extension, or at least in a state midway between flexion and extension, and passes the short pelvic diameter by a short and most compressible cranial diameter. Further, the head usually passes the brim with also a lateral obliquity. Before the engagement of the head, the sagittal suture in a

[1] Clinical Lectures by German Authors, New Sydenham Society, 1876, p. 302.

typical case will be found very close to the promontory. To engage, the head must cant over the edge of the promontory; and during the first stage of descent this suture approaches the pubis. Later on, it begins to return towards the sacrum. This last movement is owing partly to the moulding of the posterior side of the head, and partly to the greater resistance to descent at the sacro-vertebral angle, while the pubic margin of the brim offers a smooth and glib surface. The head, therefore, pivots on the promontory as a centre of motion, and, as it were, rolls over into the pelvic cavity. It "doubles the promontory," as our honored President, Dr. Barnes, so happily expresses it.

After such an unaided delivery, or after an artificial delivery in which the application of the forceps is delayed until the head has been driven past the brim, the cranium exhibits two very characteristic shears. In the one, there is a bending in of the sacral side of the head, and a bulging out of the pubic side—it is kidney-shaped. In the other, an equitation of one parietal bone over its fellow—usually the anterior over the posterior. The site of the pressure-furrow, or of the bone-lesion, varies with the size and the position of the head, and with the shape of the pelvis. It is not found at one of the poles of the biparietal diameter, and more or less parallel to the sagittal suture, as in the uniformly narrowed pelvis in which the vertex dips *ab initio*, but at the forepart of one parietal bone, close to and more or less parallel to the coronal suture. Often it lies directly over this suture, overlapping both frontal and parietal bones, and sometimes on the frontal bone alone.

When the disproportion between the size of the head and that of the brim is relatively great, or when the conjugate is short and the head unduly ossified or bullet-shaped, engagement is often delayed. Under such conditions the head does not at once become fixed by the preliminary dip of the anterior fontanelle, but it coys at the brink of the brim without entering. Perched on the sacral shelf, it swings backward and forward, and see-saws with every fœtal movement. The finger will find the sagittal suture usually close to the sacrum, and the posterior fontanelle now in front and now behind the transverse diameter of the brim; now dipping into the inlet, anon tilting up out of it. It is momentarily fixed by each uterine contraction, and then is the time to take the position. This cranial play usually ends before long, and that by the adjustment and moulding of the bicoronal region to the conjugate, and by its consequent engagement and descent. And this may be hastened, as the late Edward Martin has shown,[1] by turning the woman over on to the side towards which the forehead looks. The breech of the child then sags over to the same side, the hind-head is lifted out of the brim by the leverage of the spinal column, and the fore-head sinks in more deeply. Whenever this dipping of the fore-head does not happen, delivery without artificial aid will be indefinitely delayed.

In the foregoing description I do not pretend to have labelled all the natural processes involved, nor to have codified every law which governs the cranial movements in narrow pelves. Nor do I contend that the anterior fontanelle always dips, for the head may be a small one, or the cranium a yielding one, or other disturbing elements may intervene. But from a study of the writings of Schrœder, Spiegelberg, Martin, and Otto de Haselberg, and also from patient bedside observation, I believe that the above mechanism is in the main correct—it certainly best ex-

[1] Prager Vierteljahrsschrift, 1868, Band ii., Analect, S. 76.

plains the behavior of the head. Since, however, the truth is not always truthlike, and since the flexion of the head with the dip of the hind-head has hitherto been taught as the mode of engagement, a few more words on this point are needful.

If, in a pelvis narrowed mainly in its conjugate diameter, the hind-head always dips, and the vertex first enters the brim, as contended by Hodge and by many others, what explanation can be offered for the indisputable fact that the anterior fontanelle, at the outset of labor, is so commonly on the same plane with the posterior fontanelle, or even on a lower plane? How interpret the well-known frequency of face presentations in narrow pelves? Again, if it can be shown, that, after such unaided labors the pressure-marks or other coarse cranial lesions are found, not at one of the poles of the biparietal diameter, which is alleged to be the implicated diameter, but, as I have asserted, at the fore part of the head somewhere near the coronal suture, then the burden of reconciling this fact to theory must rest on those who hold to the initial dip of the posterior fontanelle.

Let me summon to the stand impartial witnesses, such as had no pet theories to which their facts were trimmed. And, in these forceps days, I own to some difficulty in finding cases of labor in narrow pelves which were either neglected, as we should now call it, or left entirely to the unaided efforts of nature. Nor are the following examples noting the pressure-mark, selected ones; but the *only* ones which I have been able to collect within a short and busy time.

In describing a natural labor in a pelvis whose conjugate measured about three inches and a quarter, Mlle. Anna Puéjac, midwife in chief of the Maternité at Montpellier, says[1] that "At the *anterior* angle of the left parietal bone, there was a very considerable depression, sufficient to admit the half of an ordinary egg. It was the exact cast of the promontory." Smellie writes[2] that in a case of narrow pelvis he waited until the head was "squeezed down to the lower part of the pelvis"—that is, had passed the brim. The pains failing, he then applied the forceps along the sides of the pelvis, and caught the head, which was still *transverse*, over the face and occiput. "The child's head was squeezed into a longitudinal form, flattened on the sides, with a deep impression on the cranium *above the ear*." Again he tells us that, after a woman, who was "very much distorted," "had been in strong labor for four-and-twenty hours," he found "the head down to the lower part of the pelvis," viz., past the brim, and applied the forceps first over the face and the occiput, and then, when the perinæum began to bulge, over the sides of the head. "The head was of a lengthened form, and contorted to one side, and there was a deep impression *above the ear*."

Lachapelle contends, as the result of close observation, that "the head of the fœtus, driven through a narrow and solid pelvis, is fractured and indented near one of the frontal bones. This accident is not uncommon, and we shall cite many examples of it."[3] Again, she writes, "I have remarked with Smellie (tome ii. p. 533) that, in cases of natural labors in pelves *considerably* distorted, the depression is no longer found on the frontal region (*sur le front*), but near the temporal region."[4] Out of a number of cases reported by her I select the following: Case I. Occiput

[1] Gazette Obstétricale, Juin 20, 1876, p. 179.
[2] Collection of Cases, 1778, Collection xxvii., No. 2, Cases iii. and iv. Eleventh Memoir, p. 423.
[4] Ibid., p. 429.

to the left; the anterior fontanelle *was easier to reach than usual.* A dead child was born naturally; it had the frontal boss indented and broken.[1] In another case,[2] the occiput was to the right; conjugate 3.25 English inches; a dead child was born naturally after a long labor. "The *right frontal bone*, although without fracture, offered a very marked depression which was undoubtedly due to the jutting promontory." In a third case the conjugate measured 3.25 English inches; position of the child's head not known; after six and twenty hours of labor the forceps was applied along the sides of the pelvis; "extraction prompt and easy." The left *frontal and parietal* bones were found fractured.[3] A fourth case[4] was a primipara, with a conjugate of about 3.5 English inches, and with a second position of the vertex. The forceps was applied to the sides of the head, but failed to extract; the blades were, therefore, withdrawn and applied in each ilium. There was now no further delay in delivery. The child weighed five pounds, and died twelve hours after birth. "The right *frontal* was depressed and fractured by the sacral promontory." In a fifth case,[5] the conjugate measured 3.25 English inches. The occiput looked to the left ilium; the sagittal suture lay transversely and on the sacro-vertebral angle, with the right parietal affronting the inlet.

Siebold describes a typical case of unaided labor in a pelvis of 3.5 inches.[6] At the first labor, a dead child was delivered by the forceps. At the second labor, the head presented transversely, with the occiput to the right ilium. By means of ergot a dead child was expelled. It had lesions and furrows at both temporal regions. At the third labor, the head presented transversely "with the small fontanelle to the left and the large to the right." "It was also *greatly extended* to the right," viz., the forehead dipped. After many hours of hard labor, the head was driven past the promontory, and then the vertex rotated anteriorly to the first position. Thereafter the child was soon delivered. It weighed seven pounds, was dead, and had the left temple denuded of its cuticle, at a point on a level with the small anterior inferior fontanelle (Casserius's fontanelle). At the autopsy, four fissures were found; one on the left side of the coronal suture (on the frontal bone), and three on the parietal bone. In the same journal, Carus reports an analogous case, in which there was a furrow of the parietal and a fracture of the frontal bone. Schöller, of Berlin,[7] relates a unique case of labor in a primipara with a narrow pelvis. At the end of three days the woman was delivered of a living child. "In the middle of the left parietal, and in the neighborhood of the left temple, the skin was abraded and the bone depressed." "The bone beneath died, and a portion as large as a sixpence of the whole thickness of the parietal bone exfoliated, leaving the dura mater exposed. The destruction of the frontal bone was less considerable." The Transactions of the Medical Society of Erlangen contain the history of a case of spontaneous delivery in a narrow pelvis, reported by W. J. Schmidt.[8] The child was still; its skull had a fracture and a depression on the left frontal region. In the same paper analogous examples are given by H. A. Hirt and Jörg. Another case of natural labor, in a pelvis measuring

[1] Fourth Memoir, p. 154.
[2] Eighth Memoir, p. 189.
[3] Eleventh Memoir, p. 475.
[4] Ibid., p. 469.
[5] Ibid., No. i. p. 463.
[6] Revue Médicale, 1833, tome i. p. 301; from Siebold's Journal für Geburtshülfe, B. xi. S. 404.
[7] Berlin. Medicinische Zeitung, September, 1841.
[8] Jörg, Schriften zur Kentniss des Weibes, Bd. ii. S. 123, 130.

about three inches, is given by Osiander.[1] After the most violent expulsive pains a dead child, weighing six and a half pounds, was born, with fracture of the left parietal and frontal bones. Danyau, whose excellent paper[2] has furnished me with some of these references, gives the following remarkable history of a woman whose pelvis was found after death to measure 2.75 French inches: Her first child was delivered dead by the forceps. In five succeeding labors each child offered by the breech, and one was born alive. In her seventh and eighth labors the head presented, and the children were born without aid, but dead. In her ninth labor she was brought to the Maternité. The head came first, and for four hours stayed locked at the brim. Its sacral side was then felt suddenly to bend in, and the same pain drove it down to the vulva. The child was dead. Its skull had a deep depression overlapping the left coronal suture, and shelving obliquely backward to the boss. The death of the mother on the fourth day permitted a careful measurement of the pelvic diameters.

Levret[3] writes of a natural labor in a narrow pelvis in which the "face-half" of the head was obliquely furrowed. Antoine Dugés contends,[4] that "The bones of the skull are often fractured with depression by the sacro-vertebral angle of the mother. It is one of the frontal, or, indeed, one of the temporal regions, which is the most ordinary site of these lesions." As a voucher for this statement, he gives an example of a living child born spontaneously, after a labor of thirty-six hours, through a pelvis measuring 3.25 English inches. The occiput presented to the right, and the right temple showed a red and contused furrow.[5] In another case, the left frontal bone was so depressed as to push the corresponding eye nearly out of its socket. Velpeau declares,[6] that "the depression of the parietal or of the frontal, with or without fracture, has been observed at the Maternité of Paris." Budin, a most careful observer, met with a case of spontaneous delivery in a flat pelvis measuring about 3.4 English inches in its conjugate.[7] The occiput presented to the left, and a small living child was born twenty hours after the rupture of the membranes. On the left frontal region it had a deep furrow, which started from the coronal suture at the anterior fontanelle, and ran obliquely backward toward the base of the skull. Chailly-Honoré holds[8] that "The depressions of the skull have their site ordinarily on the frontal or the parietal bones," and are often the result of natural labor in a reniform pelvis. Casper, after giving a list of writers on this subject, whose works are unfortunately beyond my reach, says that the skull-fractures caused by unaided labor are commonly on the parietal bone "and usually *transversely* to the sagittal suture." Sometimes they are found "stretching from the frontal bone more or less parallel to the sagittal suture."[9] From these citations, it follows that the site of the bone-lesions caused by a natural head-first labor in a flat pelvis, is found, not at one of the poles of the biparietal diameter, but either directly over the

[1] Handbuch der Entbindungskunst, Bd. ii. Abth. 2, S. 206.
[2] Journal de Chirurgie, par Malgaigne, Janvier, 1843, p. 42.
[3] Accouchements Laborieux, Paris, 1762, p. 119.
[4] Manuel d'Obstétrique, Montpellier, 1840, part v. sect. i. p. 306.
[5] Thèse, No. 64, 1821, pp. 51, 54.
[6] Accouchements, Paris, 1835, tome ii. p. 588.
[7] De la Tête du Fœtus, Paris, 1876, p. 58.
[8] Accouchements, Paris, 1867, p. 950.
[9] Forensic Medicine, New Sydenham Society, vol. iii. p. 118.

track of the coronal suture, or on either side of it, and generally parallel to it, and at *right angles* to the sagittal suture.[1]

After turning in a flat pelvis, or in one narrowed mainly in its conjugate diameter, a very analogous cranial mechanism takes place. The partial extension of the wedge-shaped head throws the biparietal diameter to one side of the promontory, and places in the conjugate of the brim the small bisauricular (bimastoid) diameter—viz., that portion of each temporal region lying directly in front of the ear. Now, upon traction, if the occipito-frontal diameter of the head be short, or the occipital portion of the pelvis roomy, the head will pass in the transverse (bisiliac) diameter of the brim, and in a state midway between flexion and extension, while the transit-furrow will be vertical, running directly upward from the smaller bisauricular diameter to the larger bitemporal diameter, close to and parallel to the coronal suture. If the head be large or the brim shortened in its transverse diameter, the resistance to the descent of the hind-head tends to bring about two movements; the one of flexion, and the other of occipito-frontal displacement towards the forehead side of the pelvis. The head should, therefore, pass in the resultant of these forces and of traction; viz., in a line running somewhat obliquely from the front of the ear, or from the anterior inferior angle of the parietal bone, to the vault posteriorly. But this transit-line is more vertical than in the given case of unaided head-first labor, being very generally found very near and almost parallel to the coronal suture, sometimes indeed in the very gutter of this suture-track. For the sacral side of the head being, under traction and propulsion, quickly bent in and fixed by the promontory, resists occipito-frontal displacement; while free lateral bulging at uncompressed points prevents any exaggerated lengthening out of the occipito-frontal diameter. Furthermore, suprapubic propulsion together with two movements of unremitting traction, first in the axis of the outlet and then in that of the inlet, cants the base of the skull over the edge of the promontory, causes its sacral side to be nipped high up, and makes its pubic side revolve around the promontory as a centre of motion, and descend over the glib under-surface of the pubis; in other words the head is, as I have elsewhere expressed it, warped around the promontory.[2]

Now, since this mechanism of a head-last labor in a narrow pelvis is yet mooted, I shall try to prove it by such clinical histories as note the site of the pressure-furrow. Smellie,[3] after turning in a narrow pelvis, and making traction on the child's body "with all my strength," delivered a living child, which did well, although it had "a depression of the temporal bone *before* the ear, and the frontal and parietal bones pushed outwards." Madame Lachapelle[4] advises turning in narrow pelves in

[1] In order to facilitate the work of others in this direction, I append the following references to papers on fractures of the fœtal cranium, which I have not been able to consult: Procés verbal de la distribution des prix, June 20, p. 64, et seq.; London Medical and Surgical Journal, March, 1834, p. 145; Charles West, in Medico-Chirurgical Transactions, 2d series, vol. x. 1845, p. 404; Siebold's Journal für Geburtshülfe, 1825, B. v. S. 224, B. xi. S. 400; C. F. Hedinger, über die Knochenverletzungen bei Neugebornen in Med.-gericht Hinsicht, Leipzig, 1833. The following authors have also written on the same subject: Chaussier, Meissner, Siegel, Ollivier, D'Angers, Viardel, Haller, Bosc, Berchols, Deventer, Dionis, Roederer, Baudelocque, and Stein.

[2] Philadelphia Medical Times, March 20, 1875, p. 386.

[3] Cases in Midwifery, Collect. xxxiv., No. ii., Case ii., p. 237.

[4] Pratique des Accouchements, Paris, 1825, Eleventh Memoir, p. 429.

order to make the head descend midway between flexion and extension, so as to get the "temporo-auricular diameter" in the conjugate. From several cases of head-last labor in narrow pelves, which she narrates, I select the following: Case I.[1] Primipara; conjugate 2.75 French inches; vertex presentation; forceps slipped; prolapse of the cord; version; head extracted with difficulty and with a sudden jerk (*secousse brusque*). A large girl was born alive, but did not live long. The head had a deep depression on the left frontal bone. Case II.[2] Second position of breech; conjugate 2.5 French inches; child weighed five pounds and had been dead for some time. The head had "a deep depression of the right parietal in its anterior portion and near the temple, caused by the sacral promontory." Case III.[3] First position of breech; "For more than ten minutes the head resisted the most violent tractions" (*aux efforts les plus violens*). Child did well for twenty-four hours and then died in convulsions, from the cranial lesions. An autopsy revealed the separation of the right parietal bone from the temporal along its whole inferior border.

J. J. Phillips[4] reports three cases of successful version in contracted pelves after failure with the forceps. In one of them the child had a "marked depression on the left parietal and frontal bones." Here the transit-line followed the course of the coronal suture. Carl Ruge[5] gives six cases of fracture of the frontal bone, and one along the temporo-parietal suture, after version. In the seven of my own cases[6] in which the pressure-furrow is noted, the site was near or on the coronal suture. The late Prof. E. Martin, of Berlin, says[7] that, after version, "These impressions or depressions of the respective parietal bone are *always* to be found upon its anterior portion, more or less near the coronal suture." Dr. R. Barnes avers[8] that "The mark of pressure or indentation against the jutting promontory is *always* seen at one end of this short diameter:" viz., the bitemporo-frontal. Dr. I. E. Taylor, of New York, in describing a case of labor in a pelvis measuring 2.5 inches in its conjugate diameter, states that "By version and propulsion from above the pubes, the head was flattened or indented at the junction of the parietal and frontal bones, which is the usual place."[9] Many other examples could be cited, but further evidence is needless.

From this mechanism it is clear that version closely imitates the processes of nature, for by it the head enters and passes the conjugate by its shortest diameter, where four yielding bones meet; where four wide sutures converge; where the fontanelle is large and always open; where overlapping is most free, and where compressibility is greatest. Since the resistance is limited mainly to the margin of the brim, that once passed (and generally with a well-marked jerk), there is usually no further obstacle to the descent of the head. It is now brought into relation with new pelvic diameters, and the greater friction of the broader and harder surface of the hind-head brings about the needful movements of flexion and of rotation. To effect this the line of traction must be changed to that of Carus's curve, and finally to one at right angles to the mother's body.

[1] Op. cit., Eleventh Memoir, p. 481.
[2] Ibid., p. 486.
[3] Ibid., Fourth Memoir, p. 157.
[4] Lancet, March, 1871, p. 404.
[5] Bulletin Général de Thérap., Août 15, 1875, p. 130.
[6] American Journal of Obstetrics, August, 1875, p. 197.
[7] Richmond and Louisville Medical Journal, April, 1870, p. 421.
[8] Obstetric Operations, London, 1871, chap. xvi., p. 237.
[9] Transactions of the New York Academy of Medicine, September, 1875.

But there are mechanical advantages which turning possesses over a cephalic presentation in a narrow pelvis. Outside help, that of traction and of propulsion, can be invoked without in the slightest degree interfering with the natural mechanism. Again—and this must not be overlooked—by turning, the head enters the brim by the very short bisauricular (bimastoid) diameter of its base, and passes the conjugate by the larger but more compressible bitemporal diameter of its vault; that is to say, the small end of the wedge is first nipped. In the corresponding head-first labor, the reverse to this takes place; for the head enters the conjugate by its bitemporal, or the vault portion of its bicoronal diameter. From repeated measurements taken shortly after birth, I find that the average length of the bisauricular diameter is 2.6 inches, and that of the bitemporal diameter 3 inches—a difference of nearly half an inch.

From this description of the cranial movements, it follows that turning should be limited to cases of antero-posterior shortening of the brim. For, in other kinds of narrowing, the previously described mechanism, so essential to success, could not take place. In the generally and uniformly narrowed pelvis, the transverse (bisiliac) diameter of the brim would probably be too short to permit the after-coming head to pass in a state midway between flexion and extension; while, on the other hand, if the head were forcibly flexed, a longer diameter than the bitemporal would be jammed into the short diameter of the brim. Again, from the narrowing of all the diameters of the whole pelvis—brim, bony canal, and outlet—the after-coming head would be detained at every stage of its descent, and could not, therefore, be delivered soon enough to avert fatal asphyxia. To save the life of the child, then, the forceps, and not turning, is here needed. As a corollary to this, less power and time are needed after version to deliver an average head in a flat pelvis, than a large head in an average pelvis; for, in the former, the resistance is marginal, and limited to a single osseous point; in the latter, diffused more or less, not only over the whole bony brim, but over the pelvic canal and outlet.

How to tell a uniformly narrowed pelvis from one narrowed mainly in its short diameter, becomes, then, an important question. Apart from careful digital examinations, much may be learned from measuring the distance between the anterior-superior spinous processes and that between the crests of the ilia. In a standard pelvis these distances average respectively 25 cent. (9.8 inches) and 28 cent. (11 inches).[1] But what should mostly be relied on is the position of the head. When conjugate narrowing alone exists, or when it preponderates, the occipito-frontal diameter lies parallel to the transverse diameter of the brim, with the anterior fontanelle low down. A head so situated implies conjugate narrowing and transverse amplitude of the brim. When the pelvis is uniformly narrowed, or when transverse (bisiliac) narrowing preponderates, the head will be found high up and very strongly flexed. This happens because the resistance at the brim is equal on all sides, and the shorter arm of the occipito-frontal lever must therefore descend. The sagittal suture, for the same reason as in a standard pelvis, will be found running more obliquely than transversely. Such cranial conditions show that the transverse diameter of the brim is too short to admit the occipito-

[1] Carl Martin, Monats. für Geburtsk., Dec. 1867.

frontal diameter of the head, and that version is consequently inadmissible.

Turn now to the mechanism of labor when the forceps is used at the brim of a flat pelvis. If the blades are applied to the fronto-occipital, or to the fronto-mastoid diameter, the head, which is lying midway between flexion and extension, is—unless firmly nipped in the conjugate—forcibly flexed, and either the biparietal diameter, or some diameter longer than the bitemporal, is made to enter the short diameter of the brim. Again, the fronto-occipital compression to which the head is subjected, not only prevents the natural lengthening out of the long diameters, but it causes bulging of all the cross diameters. This is, of course, a mechanical disadvantage, one which increases the difficulty of the head's transit, and which can be overcome simply by a brute tractile force—such as puts fœtal life in jeopardy. In addition, the fronto-mastoid application tends to force a premature anterior rotation of the hind-head. Also, the line of traction on the forceps-handles will invariably be at an angle to the axis of the superior strait, and the brunt of the traction is wasted on the pubis. Finally, such an application, by flexing the head or by shortening its fronto-occipital diameter, so widens the iliac spaces that prolapse of the cord is very liable to occur. "Statistics show that out of five applications of the forceps above the superior strait, no fewer than two are complicated by a prolapse of the cord. I," continues Chailly-Honoré, "have met with it in the ratio of twice in three cases."[1]

On the other hand, when the blades are applied along the sides of a head at the brim of a narrow pelvis and lying in its transverse (bisiliac) diameter, flexion is inevitable.[2] So essential, indeed, is this movement for the accurate adjustment of the blades, that some practitioners try

[1] Accouchements, 1867, p. 643.

[2] The statement often appears in foreign medical works, that this application is impracticable whenever the head lies in the transverse diameter of the brim. This is a mistake: for, although the long curved forceps then becomes virtually a straight one in so far as the pelvic curve is concerned, this application can be very generally made with a properly constructed instrument, provided the head be not locked. With the Hodge or the Davis forceps I have frequently made this application, and have repeatedly seen others make it. Hodge and Meigs, it is true, condemned it; but they denied, not its practicability but, its advisability. Baudelocque, Capuron, and Gardien, warmly advocated it, and it is now the habitual practice of some of the best obstetricians of Philadelphia. It possesses the great merits of securing the firmest grip, of compressing the head in its least vulnerable diameter, and of lessening the pressure on the bladder. Since the mode of making this application is peculiar, a description of it may not come amiss. If the occiput look directly to the left ilium—and this is the most common cephalic position in the simple flat pelvis—the woman is turned over on her back, and her coccyx made to project over the edge of the bed. The right (female) branch is first introduced in the right side of the pelvis, with the convex surface of its blade looking obliquely to the sacrum. By a rapid downward sweep and a spiral twist of its handle, together with upward pressure on the convex edge of its blade by the fingers in the vagina, it is rotated very nearly half of a circle over the forehead to the side of the child's head under the pubis. The left (male) branch is now so held at its lower convex edge by the tips of the fingers of the right hand, that its handle hangs down. While held in this position, the blade is introduced, as far as it can be made to go, in the right side also of the pelvis, over the child's left temple but under the shank of the female blade. The right hand is next carried to the still pendent handle, which it raises, and upon which it makes upward pressure. This movement, combined with a guiding pressure from the fingers of the left hand in the vagina, makes the blade glide up over the sacral side of the head. When the branches are united, the lock should press firmly on the tuberosity of the left ischium. Should the occiput look to the right ilium, the same general rules are to be observed. But now both blades are to be introduced in the *left* side of the pelvis—the left (male) blade first, and under the pubis; the right (female) with its handle pendent. The lock should now press firmly on the tuberosity of the right ischium.

first to flex the head, either by the hand, by the vectis, or by one blade of the forceps. In my own experience, however, the act of locking and that of grasping the handles, usually bring about the needful amount of flexion; for success in such an application of the forceps presupposes a certain amount of mobility of the head, which insures its flexion.

Hence the large biparietal diameter, or one of its congeners, must inevitably pass directly through the narrow conjugate. But, apart from its width, the hind-head is the least compressible portion of the cranium. The parietal bosses, being projections, as their name indicates, and being also the centres of ossification, are the most unyielding points of the vault. They are in fact eburnaceous when compared with other portions of the parietal bones. The posterior fontanelle is small, not open, and not infrequently ossified. The sutures are narrow. Only three bones meet there, the occipital and the two parietals. But the occipital bone goes to form the hard cranial base, and is incompressible. The compressibility of the hind-head is therefore limited to the equitation of the parietal bones. But being shored up and buttressed by the unyielding occipital bone underneath them, they cannot readily overlap or bend in. Hence the tedious traction needed for forceps-deliveries, when compared with that required after turning. Transit-furrows are rare, but, when present, they run anteriorly from the boss either obliquely toward the cranial base, or parallel to the sagittal suture. In a recent case of forceps-delivery this was very strikingly shown. The diagonal conjugate, measured by the rule and finger, gave a length of four inches. The sagittal suture ran transversely to the left ilium, with the large fontanelle dipping down so low as to make it almost the presenting part. The blades of the forceps were applied to the sides of the head, which flexed on bringing the handles together. After strong traction of about two hours' duration, made alternately by the attending physician and myself, the head was finally delivered. It was much flattened, and presented on its sacral side the well-marked furrow of a fracture running from the parietal bone obliquely to the mastoid process *behind* the ear. The child was still; the mother died four days afterwards from peritonitis, and I now regret not to have turned. Dugés[1] also describes such a fracture of the parietal boss in one of his forceps cases. Fractures and furrows at this site would far more frequently happen in instrumental labor, were it not that the hard boss so resists the direct pressure upon it as either to flatten the whole parietal bone, or to cause lesions of it at weaker, although unimplicated, points.

But there are mechanical objections still stronger against the forceps when compared with version. The base of the skull being unyielding, the head cannot be compressed so readily by catching the vault with the forceps. For the effect is then to direct the compressive power toward the unyielding base. But by turning, the compressive power is directed toward the yielding vault. Further, from the peculiarity of construction of the forceps, the compression exerted by it is necessarily diffused over the whole surface covered by the blades. Now, in a bilateral application, the tips of the blades cover the bones of the cheeks, which are incompressible and so narrow as to need no compression whatever. Hence, not only is this amount of compressive power misapplied and sheer waste, but it detracts by so much from that applied to the offending diameter—the biparietal. Thus the surface covered by the blades not only involves

[1] Manuel d'Obstétrique; Montpellier, 1840, part v. sect. i. art. i. p. 306.

unimplicated diameters, but it is too broad to be very materially reduced by compression. Even when the handles are lashed, but little more is gained, and that little at the expense of a prolonged, disorganizing pressure upon the brain. Baudelocque's exceptionally powerful forceps were, with lashed handles, found by their inventor barely to reduce the biparietal diameter as much as four lines, although the force applied was so great and so prolonged as to spoil the three instruments used. It follows, therefore, that the Hodge or the Davis forceps, which are much feebler instruments than the French one, cannot compress the biparietal diameter as much as three lines, and the operator is therefore compelled in narrow pelves to make the anterior portion of the brim and the promontory of the sacrum do most of the compressing work; and that by sheer and prolonged dragging force, which, as in the case just narrated, threatens injury to the mother and death to the child.

Again, the forceps-blades being of equal length and breadth, and being also applied to corresponding surfaces of the child's head, make equal compression upon the pubic and the sacral side of the head. But from the limitation of the bone-lesion in these pelves to the posterior half of the brim, the pubic side of the head needs no compression; for its convexity naturally adapts itself to the smooth concavity of the anterior half of the brim. Therefore just one-half of the effective compressive power is absolutely thrown away. For granting that, in a given case of conjugate narrowing, the forceps reduces the biparietal diameter by three lines, this diminution does not facilitate to the same extent the passage of the head; for supposing that it actually reduces the width of the head by three lines, yet it does not virtually so reduce it. This is evident from the fact that the pubic side of the head needs, not compression, but adaptation, and the bulging tissues around the periphery of the blades will at points separated by their width still impinge on the pubic concavity of the brim, making the clamped portion of the head subtend the symphysis pubis like the chord of an arc. In all the narrow pelves belonging to the museum of the Philadelphia Obstetrical Society, and one of them is under two inches in its conjugate diameter, the pubic side is concave and smooth. After a careful examination of the distorted pelves in the museum of the University of Pennsylvania, I find that the same condition obtains in all that were not affected by osteomalacia. Turn now to the sacral blade of the forceps; it is the posterior half of the brim which is distorted; and to its irregular configuration must the sacral side alone of the head be moulded. Since also the distortion is mainly owing to the descent of the sacrum as a whole, and to the anterior projection of its promontory, the portion of the head needing moulding is a small area of surface corresponding with the sacro-vertebral angle. In other words, it is, when flexion is forced by the forceps, the biparietal diameter alone that needs shortening, and that by the indentation of its sacral pole. But the very width and length of the sacral blade thwarts this indication. This blade flattens the whole sacral surface of the head, but does not mould it. The whole head and included brain are in fact flattened out by the two blades. And this excessive bilateral compression so unnecessarily lengthens out all the other diameters of the head, that every physician has seen forehead bulging out, eyeballs starting from their sockets, and life destroyed by the violent and prolonged compression to which the whole brain has been subjected. In one word, by the bilateral compression of the forceps the pubic blade interferes with the process of adaptation; the sacral blade prevents the utilization of the roomy

concavities on each side of the promontory, and the whole brain is, therefore, subjected to an unnecessary amount of compression.

The catch-word "moulding," which is so much used to designate the action of the forceps, is a misnomer. Moulding here means an outline conformity of the cranium to the kidney-shaped configuration of the brim. To attain this end, it is needful for the pubic side of the head to adapt itself to the smooth concavity of that portion of the pelvis, for the occipito-frontal diameter to be moderately lengthened out, for a limited area of the sacral side of the head to be bent in by the promontory, and for lateral bulging to take place around it in the very roomy sacro-iliac spaces. No moulding of the head, in its true obstetric sense, can possibly occur, unless, as in natural labors or by version, the pelvis itself acts the part of the moulder. Look at a head in the grasp of the forceps applied bilaterally. How is it possible for this steel-ribbed head to alter its shape to that of the brim? How can any bending-in take place within the fenestra of the sacral blade, whose iron rim, by firm pressure, acts as an abutment to the included parietal boss? How can the pubic side of the head adapt itself to the anterior portion of the pelvis? How can the head bulge out at points clamped by iron? The forceps, thus applied, indeed moulds the head, but to its own shape, and not to that of the brim. For how can bow-shaped blades mould a head to a kidney-shaped brim? The thing is an impossibility. Who ever saw a head kidney-shaped which had been delivered in such a manner through a narrow brim? The truth is that the head then passes the brim by being flattened out, and not by being moulded; and, what is worse, since the blades do not exert the needful compressive power, the promontory itself is made to do most of this unnatural work—the work of flattening and not of moulding. When the head is squeezed sufficiently flat, it is delivered by being dragged straight past the promontory, without revolving around it as it does in natural or in version cases.

So true is this that, when a head has been delivered through a small conjugate by the forceps applied bilaterally, never will it exhibit a cast of the promontory by a spoon-shaped depression, and only once have I seen a slight furrow. The whole head is flattened, the bones are separated at the sutures, sometimes so much so as to seem loose in a scalp-bag, but no lesion of limited area is found by a surface examination. Post-mortem examination will, however, reveal fissures and fractures radiating from the base of the parietal boss.

It follows that the hackneyed term of "wire-drawing" the head by the forceps, is also a misnomer. In "wire-drawing," the pincers which seize the end of the wire do not pass through the graduated holes in the draw-plate, but work outside of them. But when the head is seized by the forceps, the pincers, so to speak, must also pass through the bony draw-plate itself. So great a disadvantage is this, that there are on record far more remarkable cases of successful natural delivery in very small pelves, than there are by this use of the forceps. For it stands to reason that when a forceps, whose blades lie from two and three-quarters to three inches apart, is applied to the sides of a head at the brim of a pelvis with a conjugate of less width, the blades will need wire-drawing as much as the head, before they can be made to pass.

So far the use of the forceps. Mark now what happens when the child is turned in a flat pelvis. The wedge-shaped and semiflexed head enters the conjugate by its small bisauricular diameter, and passes it by

its very compressible bitemporal diameter. The very cause of the conjugate deficiency—the jutting promontory—becomes itself the moulder, and the plastic head, unhampered, unclamped, unribbed by bars of steel, being also drawn upon by *outside* traction, accurately moulds itself to the shape of this small bony barrier. Meantime the pubic side of the head, already presenting its convexity to a concavity, is made by lateral pressure to fit snugly the anterior half of the brim. Bulging takes place at all the uncompressed points, and the whole head becomes concavo-convex, being rapidly moulded to the kidney-shaped configuration of the whole brim, while backward traction and supra-pubic propulsion cause the pubic side to revolve around the promontory as a centre of motion. To my mind nothing can be plainer. How, otherwise, is the absence of vesical disturbance, after version, explainable? How the fact that, as I have seen and others attest, it will take as many minutes, less minutes indeed, to deliver the head by version, as it has taken hours of unsuccessful traction with the forceps? Even without these facts and without a cloud of witnesses to sustain them, an *à priori* reasoning would compel me logically to the inevitable conclusion that version possesses great mechanical advantages over the forceps.

One word in regard to the obliquely ovate pelvis. If the hind-head present in the less roomy side, by turning, the soft and voluminous breech is very likely to adapt itself and pass through the more roomy side. This tendency, together with a knowledge of the fact that the foot drawn on usually rotates to the pubic arch, ought, very generally, to enable the practitioner to place the occiput in the larger half. Yet so great an advantage is it to turn, that Barnes and Strassmann declare[1] that they have saved the children, even when they had failed by this operation to effect the desired change of position.

The use of the vectis, or tractor, in narrow pelves has been so highly lauded by Boddaert, of Brussels, Raffaele, of Naples, Fabbri, of Bologna, Marchant, Herbiniaux, Coppée, Beytter, Frayes, and other Dutch, Belgian, and Italian writers,[2] that a few words in regard to the action of this instrument are needed.

When the head is transverse, this instrument should be passed over the pubic mastoid region; when oblique and anterior, over the pubic side of the occiput; and when oblique and posterior, over the pubic fronto-temporal region. At first it is used as a lever of the "first kind," the left hand on the shank representing the fulcrum, and the right hand becoming the power by raising the handle toward the pubes. In other words, each hand acts in opposite directions—the left one mainly to protect the pubis from pressure. As soon as the handle is raised high enough for the blade to secure a good hold, the right hand is kept at rest to become the fulcrum of a lever of the "third kind," while the left acts as the power. This compound action of traction and leverage, peculiar alone to the vectis, here meets several important indications. As a lever, this instrument compresses the head from before backward in its lateral diameter, and aids the moulding of its free sacral surface to the posterior distortion of the brim. By its action as a tractor, it hooks down the pubic side of the head, making it revolve around the promontory of the sacrum as a centre of motion, and roll over into the pelvic cavity.

[1] Obstetric Operations; by R. Barnes, 1871, chapter xvi. p. 241.

[2] Cazeaux, edited by Tarnier, 1874, p. 998; Congrés Médical de France, 1865, pp. 584, 589; Traité des Accouch., par Hyernaux; Bruxelles, 1866, p. 699; New Sydenham Society's Biennial Retrospect, 1869–1870, p. 409.

From the close resemblance of this mechanism to that of an unaided head-first labor, and to that of an aided head-last labor, I am led to think that the vectis, in skilled hands, will be found more efficient than the forceps in dislodging a head from the brim of a pelvis narrowed mainly in its conjugate diameter. Below the brim, and in the generally narrowed pelvis, it cannot of course compete with the forceps excepting in certain anomalous positions and presentations. But in selected cases this neglected single-bladed instrument is, in my opinion, destined to take rank over its double-bladed fellow. For instance, in 1863, the late lamented Fabbri, of the University of Bologna, quickly delivered with the vectis, through an artificial pelvis, a head which S. Tarnier,[1] although using all his strength, was not able to budge with the forceps. The head was then replaced, and the forceps re-applied, but with the same want of success. Professor Tarnier, who is the narrator, then resorted to the lever, and, much to his surprise, delivered the head "with astonishing ease" (*avec une étonnante facilité*). This experiment was repeated, and invariably with the same result.

To sum up then the mechanism of natural and of artificial labor in a flat pelvis:—Nature makes the first-coming and the after-coming head enter the brim by extension; the forceps by flexion. With the former the head engages in the short conjugate by its shortest and most compressible diameter; with the latter by its largest and most unyielding diameter. By nature and by version the head revolves around the promontory as a centre of motion; by the forceps it is dragged straight past, over this osseous point. By the former the head is moulded to the outline configuration of the brim; by the latter, when applied to the biparietal diameter, it is moulded more to the shape of the blades than to that of the brim. By the one the brain lesion is local and limited to the area bent in by the promontory; by the other the area of undue compression is increased. By nature and by version the compression is that which is needed and no more; by the forceps it is more than is needed.

Regarding then alone the mechanism of labor in narrow pelves, to which the scope of this paper is strictly limited, the following conclusions are reached:—

I. The unaided first-coming head and the aided after-coming head observe in a flat pelvis precisely the same general laws of engagement and of descent. Hence, version here means art *plus* nature.

II. The forceps, however applied in a flat pelvis, antagonizes more or less with the natural mechanism of labor. Hence, the forceps here means art *versus* nature.

III. The aided and the unaided first-coming head observe in a uniformly narrowed pelvis precisely the same laws of engagement and of descent. But version violates these laws. Hence, the forceps here means art *plus* nature; version, art *versus* nature.

IV. At or above the brim of a flat pelvis, the fronto-mastoid or even the fronto-occipital application of the forceps interferes less with the moulding of the head, and violates less the natural mechanism of labor, than the biparietal application.

V. In the flat pelvis, the vectis aids the natural mechanism of labor, and, therefore, meets the indications better than the forceps.

[1] Cazeaux's Obstetrics, 1874, p. 996.